

Species Selection

Introduction

One of the important decision in agroforestry is the selection of species. In Agroforestry systems, people plants trees for fruit, fodder, fuel, shade, conservation purpose and various other purpose. Since a large varieties of tree are available which could grow in different edaphic climatic condition. People can select trees of their choice very easily. The plantation of trees and subsequent maintenance also depend on the agroforestry system. For example, in Shifting cultivation which is the most primitive form of agroforestry. Only fruit trees not cut while others are cut, dried and burnt to provide manure for agricultural crops. In other agroforestry systems, however trees are even more importance. They are deliberately introduced into land use. More recently, due to the generation of market opportunities for tree products greater attention has been paid to the selection of tree species in agroforestry in proper proportion.

Characteristics of an ideal tree for Agroforestry system

An ideal tree for an agroforestry system should be examined with respect to its-

- Root characteristics.
- Crown characteristics.
- Bole characteristics.
- Phenological characteristics.
- Nutrition and water absorption characteristics.
- Growth characteristics.
- Shelter to insect, pest and disease.

Root characteristics

When woody perennials are grown with annual crops, it is necessary that root distribution of trees should be below 40 cm soil layers as most of the annual crops have their roots distribution in the upper 30-40 cm soil layers. If tree roots are distributed on the surface layer of the soil, they will not only compete with agricultural crops for nutrient and water but also cause obstruction in normal soil working.

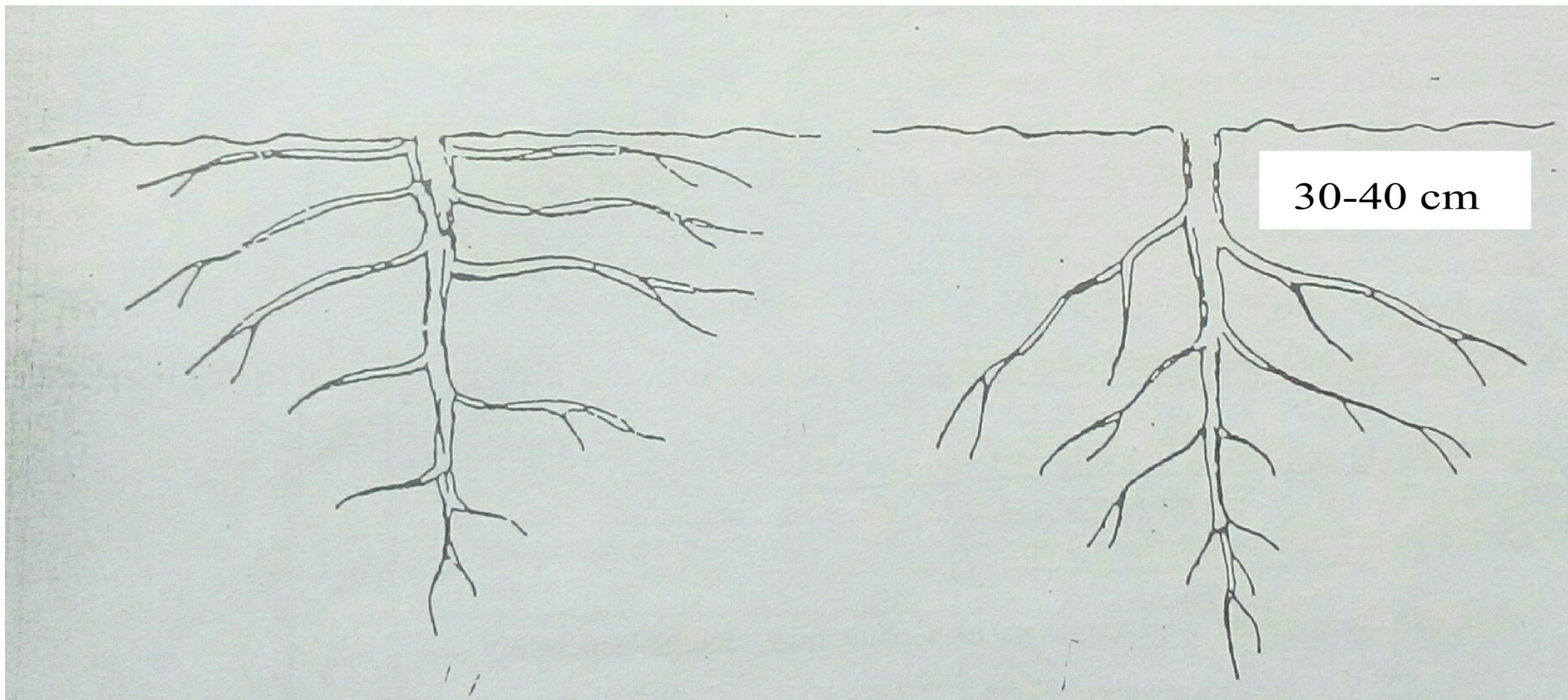


Fig: Undesirable root system.

Fig: Desirable root system.

Crown characteristics

The characteristics of a crown which are important from the Agroforestry point of view include (i) Density (ii) Size (iii) Shape (iv) Height etc. Trees having a dense crown do not permit enough light on the soil which adversely affects the process of photosynthesis in agricultural crops. The trees therefore, should have light crown which will permit enough light in the ground for photosynthesis activity of agricultural crops. Several trees such as *Eucalyptus*, *Embhca*, *Acacia* etc have a lighter crown than *Mangifera*, *Tectona* and *Dalbergia* etc in agroforestry. The smaller tree crown, the better for the mixture. The crown size and bole diameter should be as low as possible.



Bole Characteristics

The tree bole should be straight and long so that it can minimum shade to the surrounding crops. Several trees such as *Eucalyptus*, *Csuarina* etc have a long clear bole. The trees should have self pruning characteristics. If not they should tolerate a high incidence of artificial pruning, *Dalbergia sissoo* is good example of such tree which tolerate severe pruning, develop a relatively clear bole and produce quality timber.

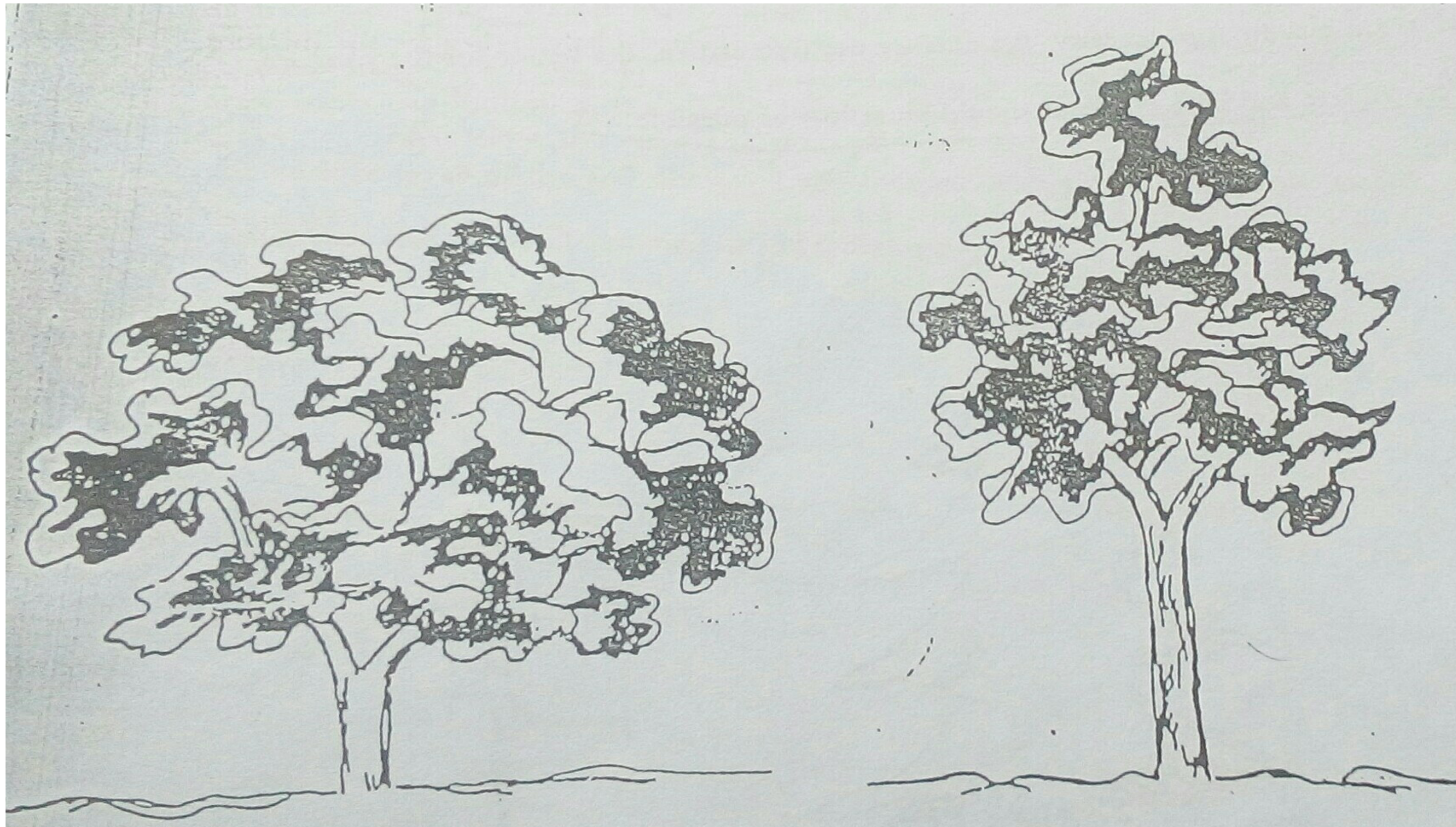


Fig: Undesirable bole system

Fig: Desirable bole system

Phenological characteristics

Phenological characteristics particularly leaf falls, emergence of new leaf, phyllotaxies etc are considered for selection of trees. Deciduous trees are especially suitable for this purpose because the competition for light, nutrient and moisture are less during the period of leaflessness. Therefore, the longer the period of leaflessness, the better for the growth of agricultural crops. Again, leaf litter of deciduous trees adds organic matter in soil and help to maintain sustainability of the productivity of the soil.

Nutrition and water requirement

Woody perennials when grown with agricultural crops it should be such that the requirement of water and nutrient are minimum.

Growth characteristics

The species selected for Agroforestry should essentially be fast growing. It should be able to withstand competition during early stage particularly when species are being selected for inter cropping. The trees should be capable of withstanding lopping, pruning and browsing.

Shelter to insect, pest and disease

The trees selected for agroforestry system should not harbour such insect, pests and disease which may damage the agricultural crops growing in association with it.

Factors Influence the Selection of Species

In general the factors influence in selection of species for agroforestry are as follows-

1. Site factors.
2. Effect on annual crops.
3. Purpose of plantation.
4. Type of agroforestry system.
5. Marketability of produce.
6. Multipurpose trees.
7. Availability of tree species.
8. Types of tree and crop species.
9. Tree function.
10. Minimum temperature.
11. Soil condition.
12. Light constraints.
13. Drainage and soil water.
14. Pest and disease.
15. Space availability.

1. Site factors

Site factor include **climate**, **soil**, **physiography**, **Biotic**. In any plantation, the species selected should first be adapted to the site condition. The climate, soil and biotic factor affect the growth and performance of trees, shrub and other forms of vegetation directly while the physiographic factors affect the climate and the soil and thus affect the vegetation.

Climate: Several climatic parameters should be considered of species selection for various Agroforestry system as total annual rainfall, humidity, number of rainy day, mean minimum and mean maximum with extreme ranges of temperature, incidence of natural calamities. e.g. frost, drought, flood etc. Each and every locality has a specific parameters which determines the choice of a limited number of species. On the basis of temperature the climate of locality may be classified as under table-

✓ Temperature zones of the country

Zone	Mean annual Temperature	Mean January Temperature	Remarks
I) Tropical	Over 24	Over 18	Cold season short or none. Frost and snow absent.
II) Sub-tropical	17-24	10-18	Cold season define but not severe. Frost during winter.

III) Temperate	7-17	-1-10	Winter pronounced with frost and snow.
IV) Alpine	Below 7	Below -1	Winter long and severe, snow common.

Bangladesh mainly lies between the tropical and subtropical zones. Only Hill ranges constitute subtropical, temperate and alpine zones. Every zone has almost a specific flora and choice of species is limited within that flora. On the basis of rainfall, the climate of a locality could be classified into the following-

- Arid when annual rainfall is below 500 mm.
- Semi-arid when rainfall is between 500 mm to 750 mm.
- Dry when the rainfall is between 750 mm to 1250 mm.
- Semi-humid when the rainfall is between 1250 mm to 2000 mm.
- Humid when the rainfall is over 2000 mm.

Soil: Soil is another site factor, which is quite important. Various soil conditions also affect the decision regarding choice of species. Several physical and chemical characteristics of soil such as texture, stoniness, drainage, pan formation, soil depth, aeration, water table, moisture regime, soil pH, soil nutrients etc. are important for selection of species. The ability of a species to establish and grow well depends on its root system and its ability to absorb moisture and nutrients. Some species indicate a preference for specific soil condition.

✓ Soil type and suitable tree species

S1 no	Soil Type	Suitable tree species
1	Desert soils	Khejur, palm, Babla, khoir etc.
2	Recent alluvium	Sissoo, khoir, nut, shimul etc.
3	Old alluvium	A large number of tropical species.
4	Saline alkali soils	Neem, goraneem, eucalyptus, Babla etc.
5	Coastal and deltaic alluvium	Khoir, sundari, gaoa, nut, coconut etc.
6	Red soils	Eucalyptus, ipil-ipil, kanthal, sissoo, teak etc.
7	Black cotton soils	Acacia, babla, bael, khejur, teak etc.
8	Laterite and lateritic soils	Eucalyptus, teak, rubber, bot etc.
9	Hill soils	Umloki, shal, teak, mahogoni etc.
10	Organic soils	Jamrul, jam, rubber, bot etc.

2. Effect of Trees on Annual crops

In Agroforestry system, the effect of trees on the surrounding annual crops is an important consideration. The tree species, which cause no or least damage to agricultural crops should be given preference. The following consideration is important:

- Species selected for Agroforestry system, should possess self pruning properties.
- If not self pruning, they should be able to tolerate frequent pruning.
- They should have small canopy and their phyllotaxies should permit the penetration of light on the ground.
- Their phenology with respect to leaf fall should be advantageous to the growth of the annual crop.
- Their rate of litter fall and litter decomposition should have a positive effect on the soil.
- Their root system and root growth characteristics should be such that it offers less competition to agricultural crops for nutrient and water.
- They should be efficient in nutrient pumps.

3. Purpose of plantation

Selection of trees for plantation in Agroforestry system must serve the purpose of the growers. The following needs should be kept in mind before selection:

- A. **Social needs:** Social need include the firewood, small timber, poles, fruits, fibres etc. Several species like neem, goraneem, Acacia etc. meet variety of needs of the community. These species serve the multi-purpose requirement of the society. Therefore, multipurpose trees should be selected.
- B. **Industrial needs:** As the natural forests are degrading day by day, selection of trees should be made in such a way that is also the requirement of the industry like plywood furniture, packing cases, sports goods etc. For this purpose, the small and marginal farmers should be encouraged to grow on marginal/degraded lands the wood species required by the industries along with the species of fuel and fodder required for their own used.
- C. **Environmental protection:** Trees are playing and important role in keeping the environment conducive for both human and animal being. Therefore, from the viewpoint of environmental conservation, the following points need to be considered-

- The species should be able to improve the site condition through conserving soil and water. Improving the nutrient cycling and regenerating the site ecologically.
- The species should be able to favorably modify the micro-climate in the area.
- The species should be able to maintain the ecological balance in the system.
- The species should be able to withstand adverse condition.

4. Types of Agroforestry systems

Selection of species depends on Agroforestry systems. For example, under the agrisilvicultural systems such species are preferred which are multipurpose, fast growing and have commercial importance. For the silvipastoral system, tree species which can yield fodder are preferred. Similarly for village woodlots, species having higher fuel wood and fodder values are generally recommended.

5. Marketability of produce

With the intensification of the demand of fuel wood, fodder and timber, there is always a crisis for these plant products and such as its market price is increasing day by day. Therefore in Agroforestry, only such species have become popular which is fast growing and capable of giving a return within about shorten possible period. Species which are able to give return in terms of timber within a period of 10 to 15 years are especially suitable for Bangladesh condition as it's farmers are poor.

6. Effect on site

The effect of a species on the site is important in the long run. The species selected should be such that it is able to protect and improve the site condition. In Agroforestry, such species need to be selected which produce leaves that are easily decomposed to form the right type of humus. The nitrogen fixing trees (NFT) having desirable characters are best as it offering the following benefits:

- NFT contribute to sustainable Agroforestry production through maintaining soil productivity. Some NFT. i.e. *Acacia* have a long and deep tap root system. While *Sesbania*, *Gliricidia* possess small leaflets that decompose more rapidly which add organic matter to the surface soil.
- Several NFT have multiple uses and provide a combination of benefits. Several species like *Acacia*, *leucaena*, *Dalbergia* etc provide fuel timber, green manure, living fences etc.
- NFT litter fall and moisture conserving shade also improves grass yield.

- Protein rich leaves and pods make many NFTs excellent forage that animals readily eat.
- Plantation crops such as coffee, cocoa and tea often benefit from the shade and nitrogen rich litter fall provided by such NFTs as *Erythrina*, *Gliricidia*, *leucaena* and others. Some farmers use NFT to fertilize shade and support crops such as pepper, vanilla and vam.
- Many NFT are planted for erosion control, watershed protection, wind breaks, leaving fences and ornamentals and for production of timber products such as tannins, gum and medicine.
- Some of the NFT are extremely fast growing.
- Some NFT have the capacity to establish in area despite heavy grazing pressure.
- A lot of NFT are specially suitable in the degraded site like saline soil, acidic soil, alkaline soil, soil with drainage and drought affected soils where other species rarely withstand.

7. Multipurpose Trees (MPTs)

The term "*multipurpose tree*" refers to all woody perennials that are purposely grown so as to provide more than one significant contribution to the production or service functions (food, fodder, fuel, timber, shelter, shade, land sustainability) of the land use system they implement. Accordingly, a tree which will serve more than one purpose is a multipurpose tree. A single tree may serve more than one purpose. For example, *Gliricidia sepium* that in addition to green manure provides fuel, fodder and acts as live fence.

Characteristics of MPTs suitable for Agroforestry

- Adaptability to local climatic conditions.
- Ease of establishment from seeds and seedlings.
- They should have a low crown diameter to bole diameter ratio.
- They should be light branching in their habit.
- They should tolerate relatively high incidence of pruning.
- Deep thrusting tap root system and few and shallow lateral roots (or prunable).
- Their phyllotaxies should permit penetration of the light of the ground.

- Good Coppicing ability.
- Effective nutrient recycling.
- Multiple uses: food, feed, firewood, construction materials and other products and service (shade, shelter etc.)
- Minimal competition with shallowly rooted annual crops.
- Small leaflets readily detached when dried and quickly decomposed when used as fertilizer.
- A high proportion of leaves to secondary branches.
- Good tolerance for drought, low fertility and others.
- Freedom from pests and diseases.
- Not compete for moisture, space and air.
- Ability to fix atmospheric nitrogen.
- Supply nitrogen in the soil.
- Have thin and erect leaves.
- Maintain proper ecosystem.
- Non-allelopathic effects on arable crops.
- Easy to propagate and prolific seed producer.

Benefits/Services from MPTs

The benefits from MPTs can be summarized as follows:

A. Food

1. Human food from trees (fruits, nuts, leaves etc.).
2. Livestock feed from trees.
3. Improved nutritional status of food and feed crops through:
 - a) Nitrogen fixation.
 - b) Access to greater volume of soil nutrients through deep rooting trees.

c) Improve availability of nutrient associated with higher cation exchange capacity and organic matter levels.

4. Increased crop production through soil and water conservation.

B. Energy

1. Firewood for direct combustion.

2. Pyrolytic conversion products (charcoal, oil, gas etc.)

3. Produces gas from wood or charcoal feed stocks.

4. Ethanol from fermentation of high carbohydrate fruit.

5. Methanol from destructive distillation or catalytic synthesis processes using woody feedstock.

6. Oils, latex, other combustible saps and resins.

C. Shelter

1. Building materials for shelter construction.

2. Shade trees for humans, livestock's and shade loving crops.

3. Windbreaks and shelter belts for protection of settlements, crop land and pastures.

4. Living fences.

D. Raw materials for processing

1. Wood for a variety of craft purpose.

2. Fiber for weaving industries.

3. Fruits, nuts etc for drying another food processing industries.

4. Tannins, essential oil, medicinal ingredients.

E. Cash

1. Direct cash benefits from sale of above listed production.

2. Indirect cash benefits from increased production of crops or livestock.

F. Long term benefits

1. Increased crop productivity.
2. Sustain crop productivity.
3. Improve environmental condition.
4. Improve socioeconomic condition.

Coppicing

In Coppicing, whole tree is cut off close to ground level. Shoots sprout from the residual stump technically referred to as the stool. Removal of the trees leading shoots results in hormonal suppression of lateral growth which triggers growth of dormant buds on the side of the trunk. Coppice growth is generally much more vigorous than normal seedlings growth.

Points to keep in mind during coppicing

- Trees should be coppiced only when attains good health and shade effect is too much on the inter crops.
- Trees should be coppiced when attains 3-5 meter height.
- Trees should not coppiced in dry period. In dry fallow period shade of trees help in moisture conservation.
- Coppicing should be done one week before the onset of the rains.
- The optimum cutting height for most of the coppicing trees should be kept in between 30-50 cm above the ground level.
- Initial cut must be angled to permit rainwater to run off from the cut surface easily.
- In case of poor shoot growth, mature trees should be harvested and replanted by new seedlings.